ENTREPRENEUR'S RESOURCES, TECHNOLOGY STRATEGY, AND TBF's PERFORMANCE

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Abstract. Many studies have attempted to identify the factors that explain the performance of the new TBF and its probability of success. These investigations normally analyse the resources available to the entrepreneur when founding the firm or the strategy chosen to compete as antecedents of the new venture's performance. Alongside these previous works, this study is based on the configuration approach and argues that the new TBF's strategic and financial performance depends on how well the entrepreneur's resource endowment allows the chosen strategy to be executed, in other words, the fit between the entrepreneur's resources and the chosen strategy. The authors study this idea by using a sample of 165 Spanish new TBF. The findings support relevant drawn up hypotheses. Specifically, one indicator of venture strategic performance, that is, early internationalization is shaped by the match between entrepreneurs' endowments of human and social capital, and the technological pioneering strategy. That match is also related to a TBF's economic profits. Practical implications are discussed.

Código JEL: F23 (Multinational Firms; International Business); L25 (Firm Performance); L26 (Entrepreneurship).

1. INTRODUCTION

The new technology-based firm (TBF) can be conceptualized from a broad perspective as a new, independent, owner-managed small or medium-sized enterprise (SME) operating in a high-technology industry (Storey and Tether, 1998). According to Aaboen *et al.* (2006: 955), these entrepreneurial firms can be conceived '[…] as new start-up businesses formed individually or by a group of founding entrepreneurs'. Many studies have attempted to identify the factors that explain the performance of the new TBF. Although the entrepreneur's resources and strategy have been commonly studied as antecedents of the new venture's performance (Boulding and Christen, 2003; Kakati, 2003; Lee and Grewal, 2004), the results obtained for the new TBF are divergent. Various studies show that some of the entrepreneur's resources and indicators of the strategy have positive influences, others have a negative effect, and yet others have no effect at all (e.g., Aspelund et al., 2005; Atuahene-Gima *et al.*, 2006; Kakati, 2003; Newbert et al., 2007). Alongside these previous works, this study is based on the configuration approach and argues that the new TBF's strategic and financial performance depends on how well the entrepreneur's resource endowment allows the chosen strategy to be executed.

Competence-based view (e.g., Prahalad and Hamel, 1990), frequently described from a resource perspective (Walsh and Linton, 2001), argues that the distinctive capabilities of new TBFs are closely associated with the knowledge and skills of their founders (Feeser and Willard, 1990): the entrepreneurs' managerial capabilities and technological competencies (Marino, 1996; Newbert *et al*., 2007). Managerial capabilities refer to the skills, knowledge, and experience that enable the entrepreneur to manage the complexities of the new TBF (Eisenhardt and Schoonhoven, 1990). Technological competencies refer to the ability to apply scientific and technical knowledge to develop and improve products and processes (McEvily *et al.*, 2004). In addition, Prahalad and Hamel (1990) also consider that ventures can benefit from network ties, since they can use them to learn core competences from partners. Thus social resources are important because they have to do with the entrepreneur's ability to develop and maintain agreements and obtain valuable tangible and intangible resources–such as complementary technology and financial resources–from their social networks and memberships (Colombo and Grilli, 2005; Davidsson and Honig, 2003).

Therefore, the entrepreneur's human and social resource endowment that makes the strategy implementation possible is very important since it conditions the performance of any new technological business (Chorev

and Anderson, 2006; Newbert *et al*., 2007). Consequently, entrepreneurs should choose those strategies requiring resources they have to hand or to which they have access. Although there are different strategic decisions that an entrepreneur must make to guide the technology-based venture's actions in the market, our focus is on the technology strategy, that is, the creation, use and successful commercialization of technology through innovative products/services, because this has been regarded as one of the most important factors in the performance of the technological new venture (Park and Bae, 2004; Zahra, 1996; Zahra *et al.*, 1995). Entrepreneurs can choose to be pioneers, developing a technology that is innovative in the market and used exclusively by their firm, or followers, adopting accepted standards and improving products initiated by pioneers.

Regarding the venture's performance, the literature has mainly dealt with financial variables such as profits or the firm's value in the market (e.g., Boulding and Christen, 2003; Lee and Grewal, 2004). However, Kaplan and Norton (2001) argue that such indicators only give information on the results at the end of the fiscal year, and are therefore causally and temporally separated from improving in firms' capabilities. Furthermore, because strategy involves all dimensions of corporate behavior, organizational performance must be analyzed with a broader range than merely financial ratios (Durand and Coeurderoy, 2001). Indeed, financial results are important but not sufficient to know how the TBF's sources of competitive advantage progress, with this competitive advantage being responsible for its future development.

Specifically, and because TBFs operate in high-tech entrepreneurial environments with frequent ground-breaking changes and shorter product life cycles (Chorev and Anderson, 2006), strategic performance measures become relevant–e.g., geographic scope of activity (Fernhaber *et al.*, 2009) and customer satisfaction (Zahra *et al*., 1995). Particularly important for new TBFs is the geographic scope of activity, with early internationalization in these firms the focus of many studies (e.g., Crick and Spence, 2005; Spence and Crick, 2006). This is because if a mere local geographical scope is achieved, the high investment in R&D that the pioneering strategy entails could be difficult to recover. The new TBF will also risk being unable to renew its offer of products at the speed required by the industry, and so international expansion can become important for its survival and growth (Chorev and Anderson, 2006; Spence and Crick, 2006). However, research on early and rapid internationalization of the new venture is rather inconclusive and researchers emphasize the importance of finding a new theoretical framework for explaining this complex

phenomenon that challenges the dominant logic of time-based experience and accumulation of resources as prerequisites for internationalization (Crick and Spence, 2005; Weerawardena *et al*., 2007; Zahra *et al*., 2005).

Additionally, the financial results could be initially poor for a TBF that develops a strategy that is technologically pioneering in its first years of business as this requires a high initial investment (Aspelund *et al*., 2005; Zahra *et al*., 1995) and offers an innovative product with low sales initially as it is in the early stages of its life cycle (Walsh *et al*., 2002; Zahra *et al*., 1995). Thus the complementary use of strategic and financial measures of performance is important when researching TBFs and especially the outcomes of the technological pioneering strategy.

Following Ndofor and Priem's (2011) and Shrader and Siegel's (2007) approach, it could be said that the degree of fit between entrepreneurial human and social resources and the chosen technology strategy is a critical factor, because the TBF's strategic and financial performance will depend on how well the entrepreneur's resource endowment allows the chosen strategy to be successfully executed. Thus we extend the above authors' ideas to *explore whether the new TBF's strategic and financial performance is determined by the direct effects of the entrepreneur's human and social resources or rather by the degree of fit between the entrepreneur's resource endowment and the needs of the chosen technology strategy*. We provide empirical evidence from 165 TBFs to study configuration effects. From the discussion of the theoretical foundations and the empirical evidence we advance some propositions for testing in future research.

This research has the potential to make several contributions. First, because we have not found any research that analyses the effect that the resource-technology strategy fit has on the TBF's strategic and financial results, it is possible that this line of enquiry may provide new evidence that shed light on the real influence that the entrepreneur's resources play on the TBF's success. Second, this work can further our understanding of the factors that explain the early internationalization of the new TBF because we examine the conditions under which the chosen technology strategy allows for this international expansion as a measure of its strategic performance. Again, and unlike any previous studies that focus on the direct effects of antecedent variables on early internationalization (e.g., Fernhaber *et al*., 2009), the current work, based on the configuration approach, analyses the effect of the resources-technology strategy fit as an antecedent of

international performance.

2. THEORETICAL FOUNDATIONS

New ventures often face resource constraints because of their liability of newness, (Atuahene-Gima *et al*., 2006; Ruiz-Ortega and Garcia-Villaverde, 2010). Such limited resources are particularly important because of their simpler structure and lack of organizational inertia (Shrader and Siegel, 2007). Thus for entrepreneurs the ability to access and marshal internal and external resources is the key success factor for long-term higher performance (Park and Bae, 2004). Specifically, human and social resource accumulation is critical (Cooper *et al.,* 1994). But Ketchen *et al.* (2007) argue that no direct resource-performance link exists and resource endowment only has potential value in helping the firm to adopt and implement strategic actions. In fact, authors such as Barney (1986) suggest that the strategy a firm selects and can successfully implement is constrained by its resource endowment. Thus and unlike the previous literature that analyses the direct effects of the entrepreneur's resources on new venture performance, here we analyze whether the effectiveness of a strategy is determined by how well it fits the entrepreneur's resource endowment.

Configuration theory generally proposes superior performance for organizations that resemble an ideal type proposed by theory (Doty *et al.,* 1993), where each ideal type is a theoretical construct used to represent a holistic configuration of organizational factors (McKinney, 1966)–e.g., accumulation of those human and social resources needed to implement the chosen strategy. Thus according to configuration theory and extending Ndofor and Priem's (2011) approach, the more closely a new venture is aligned with the ideal type for the chosen strategy, the better its performance will be. Specifically, we study the influence of the entrepreneur's resource endowment-technology strategy fit on the TBF's strategic and financial performance.

2.1. The technology strategies of TBFs

There are different strategic decisions that an entrepreneur must make to guide the new TBF's actions, among which the technology strategy is particularly important because it displays the most significant differences across TBFs (Aspelund *et al*., 2005) and is one of the most important factors with regards their performance (van de Vrande *et al.,* 2011; Zahra, 1996; Zahra *et al*., 1995). Specifically, because new ventures often face resource constraints (Atuahene-Gima *et al*., 2006), they must seek advantages by

embracing and commercializing emerging technologies as the core of their competitive strategies (Walsh *et al*., 2002). They must be able to find or create a market for innovative products that satisfy unmet needs, and in this market there will be no incumbent firms offering direct competition (Atuahene-Gima *et al*., 2006). They can also enter existing markets with innovations based on disruptive technologies (Walsh *et al*., 2002).

According to Zahra *et al*. (1995), the technological pioneering strategy is the creation, use and successful commercialization of technology through innovative products/services. This conceptualization combines developing the technology with commercializing it in the market, as other authors suggest (e.g., Park and Bae, 2004; Zahra, 1996), since creating new technologies is not sufficient to achieve profitability: new TBFs must also commercialize these technologies (Zahra *et al*., 1995).

The pioneering strategy consists of using a disruptive technology that is innovative in the market, developed by the venture and used exclusively by it (Park and Bae, 2004; Utterback, 1994). Thus technological pioneering entails developing technologies with no technological predecessors (e.g., Banerjee and Cole, 2011) and commercializing them on the market (Zahra *et al*., 1995). Pioneering creates unique and superior products that are highly innovative. Thus this strategy forms a potential production base for industry standard products (Thukral *et al*., 2008) and could allow the TBF to participate voluntarily in standard-setting processes (Rysman and Simcoe, 2008). In contrast, the follower strategy is based on adopting and imitating pioneering technologies in such a way that the new TBF follows accepted industrial standards and improves products initiated by pioneers (Park and Bae, 2004; Utterback, 1994).

The literature discusses the possible advantages and disadvantages of the pioneering strategy in terms of demand and cost implications (Boulding and Christen, 2008). Among others, some advantages are that the disruptive ideas usually provide differentiated and technologically superior products (Utterback, 1994) and a reputation as leader (Zahra *et al*., 1995), both generating high barriers for competitors (Chorev and Andersen, 2006). Cost-side advantages include pre-emption of factor inputs as the TBF could close early negotiations with suppliers more favorably than later entrants can (Boulding and Christen, 2008). Thus new ventures can use first-mover advantages to outperform incumbents (Park and Bae, 2004; van de Vrande *et al*., 2011). The disadvantages of pioneering include a higher risk in terms of functionality of the resultant product or timely acceptance because of customer resistance (Thukral *et al*., 2008; Walsh *et al*., 2002; Zahra *et al*., 1995). Thus they embrace the challenge of demonstrating market potential and providing evidence for

forecasted profits (Walsh *et al*., 2002) necessary to receive financing for the new entrepreneurial project. Furthermore, followers can sometimes quickly imitate the main characteristics of products, and exploit them much more cheaply than the pioneers and hence the new TBF's first-mover advantages may not be sustainable (Ruiz-Ortega and Garcia-Villaverde, 2010).

The pioneering strategy is consequently '[…] a double-edged sword, creating and destroying value' (Zahra *et al*., 1995: 20). Thus the choice of a suitable technology strategy is critical for the long-term viability of the new venture (Bantel, 1998). To maximize the rewards and limit the risks from the pioneering strategy, entrepreneurs should consider the conditions that make such a strategy profitable (Zahra *et al*., 1995). Thus although researchers have argued for the existence of a direct effect of strategy on new venture performance (Baum *et al.*, 2001; Eisenhardt and Schoonhoven, 1990), it is possible that such an effect depends on the resources allowing for this to be implemented (Shrader and Siegel, 2007). To this end, Ruiz-Ortega and Garcia-Villaverde (2010) maintain that even when the environmental conditions are unfavorable for obtaining first-mover advantages, the possession of certain resources that allow a TBF to create strong resistant barriers making it difficult for new competitors to enter will encourage the firm to choose a pioneering strategy. As a result, differences in entrepreneurs' resources necessary for pioneering could have an influence on the successful implementation of the technological pioneering strategy (Lieberman and Montgomery, 1998).

2.2. Entrepreneur's resource endowment necessary to successfully implement the technological pioneering strategy

Although in established firms pioneering technologies are mainly the responsibility of the R&D department, in new ventures they are the responsibility of the entrepreneur who founds the firm (Walsh *et al*., 2002). Thus the successful pursuit of the technological pioneering strategy requires that the entrepreneur must possess high endowments of human and social resources in order to exploit the advantages and to lessen the disadvantages stemming from such a strategy.

With regards the human resources, the literature on core competencies has identified that the entrepreneur's managerial capabilities and technological competencies (Marino, 1996) are relevant to the technology strategy that the TBF selects (Newbert *et al*., 2007). In the case of the technological competencies, the fact that the entrepreneur or the entrepreneurial team (Colombo and Grilli, 2005; West III, 2007) has higher

qualifications in technology-related areas and a large capacity for learning is critical to successfully implement a pioneering strategy (Aspelund *et al*., 2005). In these cases the entrepreneur has to develop new pioneering technologies that bring about disruptive innovations with new products in the market. Alternatively, the founders should be able to suitably understand those pioneering technologies that have already been developed but not yet exploited by external agents–e.g., universities–enabling the development of entrepreneurial alertness in order to identify business opportunities. However, technical abilities, although a necessary aspect of the entrepreneur's resources, may not be a sufficient condition to ensure success in implanting a pioneering strategy (Zahra *et al*., 1995). The entrepreneur's managerial capabilities can also be considered determining qualities (Kakati, 2003), because they have to be able to position the innovative products offered by the TBF in domestic and/or foreign markets. As long as these products are unfamiliar, there may be little interest in the market in them (Chorev and Anderson, 2006). Thus the entrepreneur must be capable of understanding market characteristics to be able to rapidly implement effective marketing-mix strategies and have an influence on the formation of consumers' preferences (Ruiz-Ortega and Garcia-Villaverde, 2010). The TBF can then achieve early competitive positioning in multiple markets (Weerawardena *et al*., 2007).

With regards the social resources, and given the liability of newness and the complex and dynamic nature of the technological environment, entrepreneurs in TBFs are often interested in joining social and business networks (Hagedoorn, 2002), from which they can obtain the help they need to successfully implement the pioneering strategy. With respect to financial resources, financial institutions–e.g., banks, leasing companies–usually prefer to finance business projects that are, a priori, less risky. They also find it difficult to recognize successful technological pioneering projects due to asymmetric information between the two parties (Colombo and Grilli, 2005). As a result, TBFs following the technological pioneering strategy usually face barriers when seeking financial resources. Thus access to investment partners such as venture capital firms or business angels (Collinson and Gregson, 2003; Neck *et al*., 2004) is an alternative source of finance for these high-technology projects (García-Soto and García-Cabrera, 2010). Investment partners can also offer other benefits as they often provide managerial support (Sapienza *et al*., 1996), so they often condition the TBF's success (Chorev and Anderson, 2006).

In addition, Prahalad and Hamel (1990) consider that ventures can benefit from alliances, since the

entrepreneur can learn core competences from partners. Specifically, technology partners, as a source of external knowledge resources, may offer the founders of a TBF those technological resources that they need to complement its core technical competences and implement a pioneering strategy (Walsh *et al*., 2002). External technological resources include explicit knowledge, usually legally protected via licenses or patents of disruptive technologies, but also tacit knowledge, not directly acquirable in the markets (Díaz-Díaz *et al.*, 2006). Although market transactions allow the entrepreneur with financial resources to acquire protected technologies, the founder's ability to develop agreements with other organizations such as research centers (Ucbasaran *et al.*, 2008) may help the TBF to capture tacit and/or explicit knowledge (Lefebvre *et al.*, 1998) at reasonable cost. This is extremely important for the new TBF, as it often lacks financial resources. The literature shows the positive influence that networking has on TBFs by supplying preferential access to partners' technological knowledge and capabilities (West III and Noel, 2009) necessary to carry out disruptive innovations that facilitate the development of the pioneering strategy. Hence, building and maintaining relevant and effective networks are a fundamental part of successfully implementing a pioneering strategy.

Based on the previous review, the ideal type we propose for the new TBF when the technological pioneering strategy is chosen is: high human resources–i.e., technological competences and managerial capabilities–and social resources–i.e., investment partners and technology partners. According to configuration theory and extending Ndofor and Priem's (2011) approach, we suggest that the more closely a TBF is aligned with this ideal type, the better its strategic and financial performance will be.

H1. The better the fit between the TBF and the theoretically derived ideal type, the larger the venture financial performance.

H2. The better the fit between the TBF and the theoretically derived ideal type, the larger the venture strategic performance.

3. METHODOLOGY

3.1. Population and sample

The population in this study consists of the new TBFs in the 17 regions of Spain. To determine the number of new TBFs, we reviewed the literature and established the criteria for cataloguing a firm as such according

to Storey and Tether's (1998) conceptualization. A business venture is regarded as a new TBF when: it has fewer than 250 employees (Eurostat, 2008); is less than six years old (Shrader and Siegel, 2007); is not integrated in a corporate group (Spence and Crick, 2006); and operates in a high-technology sector, following the OECD's (2001) classification of industries based on technology. Although we use the restrictive criterion of six years to catalogue a firm as new, according to Bantel (1998), Ruiz-Ortega and García-Villaverde (2010) and Zahra *et al*. (2000) we could have considered firms up to 10 years of age, as firms of 12 years have survived the liability of newness.

Using the SABI database (2008), it was possible to identify a total of 9,205 TBFs. On average, the regions have 541 firms each, and the average firm has been operating for 66.5 months (5.5 years), is small in size with an average of nine employees, and operates in a high-technology industry. According to the Spanish sub-classification of industries based on technology, the firms operate mainly in high-technology industries (71.3%), with only 28.7 percent working in medium-high-technology industries. The sample selection followed a proportional stratification sampling method for age, size (number of employees), and the categories of medium-high and high technology. The fieldwork was carried out from January-July 2009, a period in which we were only able to contact by telephone a third of the identified firms in each region (3,068 TBFs in total) due to the financial limitations of the study. After contacting these TBFs, an invitation was sent by e-mail including a link to access an electronic self-administered structured questionnaire to those who agreed to participate in the research. The response rate was 5.9 percent as 180 TBFs accepted the invitation and completed the questionnaire. On analyzing the internal coherence of these questionnaires, five were subsequently discarded, so the final sample consisted of 175 TBFs (with a sample error of 5.29%). With regards the representativeness of the firms participating in this study, they have been operating for an average of 84.5 months (approximately seven years). The slight difference compared to the population mean is because the data available from the SABI (2008) database corresponds to the firms' situation in December 2006, whereas this fieldwork was carried out in 2009. This average age is slightly above the initial criterion of six years, but it is well below Zahra *et al*.'s (2000) limit of 12 years for considering that a firm has survived the liability of newness. Furthermore, the sample firms were founded on average by a team of 2.7 entrepreneurs and at the time of the study had an average staff of 19.3 employees, likewise higher than the population mean identified in the SABI database. 88.5 percent of the sample firms operate in a high-

technology sector. Thus the sample obtained is diverse and qualitatively representative of the target population of new technology-based firms in Spain.

3.2. Measures

Human Resources. This was operationalized with the following indicators referring to the entrepreneurs who founded the TBF: i) Degree in Business Administration or economics; ii) Master in Science or Technology; and iii) previous work experience in management in a large firm. Each of these indicators is measured on a 5-point scale, where 1 means that any of the founders has this, 3 means that at most 50 percent of the founders have this, and 5 means that all the founders have this.

Social Resources. Respondents were asked about the support they received when starting up the venture. Possible answers are: i) investment partners; and ii) technology partners. The answers are measured on a 7-point Likert scale, where 1 means low support and 7 high one.

Venture strategy. This variable came from a survey question rated by the entrepreneurs who answered it. That question was: My firm uses a technology that is innovative in the market, was developed by the firm and is used exclusively by it (we are technological pioneering). Venture strategy is a dummy variable that equals 1 if the firm uses a pioneering strategy, 0 otherwise.

Performance. Past studies reveal that new venture performance is multidimensional in nature (Kakati, 2003), so eight variables were used to measure the TBF's results. The first of these variables, the profits (earnings before taxes), was obtained from the SABI database, which includes firms' annual accounts reported to the authorities, indicating the quantitative and secondary nature of this financial information. The remaining 7 variables were measured on a 7-point Likert scale, where 7 means total satisfaction with the strategic performance achieved by the TBF. The items are: i) sales growth in domestic market; ii) sales growth in foreign markets (international scale); iii) market share growth; iv) increase in number of foreign markets (international scope); v) customer satisfaction; vi) success of the venture; and vii) expected growth. This last set of seven Likert scale variables was reduced to two hypothetical variables using factor analysis. After applying the Harris-Kaiser oblique rotation method, the variance explained by Factor 1 and Factor 2 is 48.5 percent and 23.2 percent of the total variance, respectively. The results show that the Kaiser-Meyer-Olkin (KMO) Test and Bartlett's Test of Sphericity (χ^2) both offer satisfactory levels (KMO=0.748;

χ^2=580.620***). Cronbach's alpha coefficient indicates that the scale used has internal consistency (0.802). Table 1 shows the factor pattern. The first factor loads high on variables dealing with generic and domestic issues, while the second factor loads high on variables dealing with foreign market issues. As all the firms in the sample are young and independent, we can say that the second factor refers to early internationalization (e.g., Kuivalainen *et al.*, 2007; Weerawardena *et al*., 2007).

Table 1. TBF's strategic performance: Factor analysis

Variables	Factor 1 Generic and domestic performance	Factor 2 Foreign market performance
Sales growth in domestic market	**.831**	-.206
Sales growth in foreign markets	.524	**.786**
Market share growth	**.793**	-.054
Increase in no. of foreign markets	.465	**.820**
Customer satisfaction	**.606**	-.465
Success of venture	**.858**	.176
Expected growth	**.695**	-.210
Kaiser-Meyer-Olkin Test	.748	
Bartlett's Test of Sphericity (χ2)	580.620***	
Variance explained	71.7%	
N	165	

****p*<.01.

Fit. Our theory building suggested that the closer the fit between each TBF and the ideal type of new venture–i.e., high human resources and high social resources when the technological pioneering strategy is chosen–the better its performance will be. Thus we established the ideal profile using the maximum values for each variable. Next, the distance was measured as the deviation of each venture's profile from the ideal type. Let x_k be a variable measured on a Likert scale. Then, the square of the distance between venture j and the ideal profile i on variable x_k is

$$d_{ijk}^2 = \left(\frac{x_{ik}}{r_k} - \frac{x_{jk}}{r_k}\right)^2$$

where r_k is the rank of variable x_k. Thus if the venture fits the ideal type perfectly, then $x_{jk}= x_{ik}= x_{max}$ and $d_{ijk}=0$. If the venture does not fit the ideal profile and, for example, $x_{jk}=x_{min}$, then $x_{ik} - x_{jk} = x_{max} - x_{min} = r_k$ and $d_{ijk} = 1$, which is the maximum possible value for d_{ijk}. As the ideal type was measured with multiple variables, we calculated the deviation D_{ij} as the average distance along all relevant K dimensions. Mathematically,

$$D_{ij} = \sqrt{\frac{1}{K}\sum_{k=1}^{K} d_{ijk}^2}$$

Finally, the fit *F* is calculated as follows: $F_{ij} = 1\text{-}D_{ij}$.

Control variables. We statistically controlled for a number of additional factors that could affect venture performance. These controls included founder's age (in years) and gender (female=0, male=1), and level of venture innovation. We controlled for innovation with three items indicating whether the entrepreneur: emphasizes differentiation based on innovation; emphasizes R&D and continuous technological development; and is satisfied with the relation between actual and expected number of patents granted since the firm's founding. These three issues can be used to measure the venture's level of innovation. Each of these three items was measured on a 7-point scale, where 1 = totally disagree and 7 = totally agree, and they were reduced to one hypothetical variable using factor analysis. A principal components factor analysis was carried out (KMO=0.580; Bartlett's Test of Sphericity χ^2=94.160***; N=166) providing one factor that explained 60.05 percent of the variance and a Cronbach alpha of 0.633.

3.3. Data analysis

Strategy status (i.e., pioneer or follower) may be endogenous if the decision to pursue or not to pursue the strategy is correlated with unobservables that affect performance. For example, if more able entrepreneurs are more likely to follow a pioneering strategy and therefore their ventures achieve – ceteris paribus – superior performance, then failure to control for this correlation will yield an estimated effect of strategy on performance that is biased up. The two-step correction procedure recommended by Heckman (1979) was therefore used. Let V_{ij} be the maximum attainable utility for entrepreneur *i* if he/she chooses strategy *j* (*j=1 or 2*). The central presumption is that *i* will choose strategy 1 over 2 if $V_{i1}>V_{i2}$, and 2 over 1 if $V_{i2}>V_{i1}$. The utility function can be assumed to be a linear function of exogenous variables:

$$V_{i1} = \Sigma a_{k1} W_{ik} + v_{i1}$$

$$V_{i2} = \Sigma a_{k2} W_{ik} + v_{i2}$$

Then, V_{i1} will be greater than V_{i2} if $V_{i1}\text{-}V_{i2}>0$ and V_{i1} will be less than V_{i2} if $V_{i1}\text{-}V_{i2}<0$. Suppose we let Z_i^* be this difference, then:

$$Z_i^* \equiv V_{i1}\text{-}V_{i2} = \Sigma(a_{k1}\text{-}a_{k2})W_{ik} + (v_{i1}\text{-}v_{i2})$$

We can simplify the above equation by letting $\gamma_k = a_{k1}\text{-}a_{k2}$ and $u_i = v_{i2}\text{-}v_{i1}$, obtaining:

$$Z_i^* = \Sigma \gamma_k W_{ik} - u_i$$

The choice perspective states that entrepreneur *i* chooses strategy 1 over 2 if $V_{i1} > V_{i2}$ or if $Z_i^* > 0$. But this means that strategy 1 is chosen if $\Sigma \gamma_k W_{ik} - u_i > 0$, i.e., if $u_i < \Sigma \gamma_k W_{ik}$. If Z_i, the observed strategy chosen by entrepreneur *i*, is equal to 1 when $Z_i^* > 0$ and is equal to 0 when $Z_i^* < 0$, then we are led naturally to a probabilistic statement:

$$P(Z_i=1) = P(Z_i^* > 0) = P(u_i < \Sigma \gamma_k W_{ik}) = \Phi(\Sigma \gamma_k W_{ik})$$

$$P(Z_i= 0) = P(Z_i^* < 0) = P(u_i > \Sigma \gamma_k W_{ik}) = 1 - \Phi(\Sigma \gamma_k W_{ik})$$

where $\Phi(\cdot)$ is the normal distribution function. Next, the inverse Mills' ratio was calculated as follows:

$$\widehat{\lambda_i} = \frac{\phi(\Sigma \gamma_k W_{ik})}{\Phi(\Sigma \gamma_k W_{ik})} for Z_i = 1 \; and \widehat{\lambda_i} = \frac{\phi(\Sigma \gamma_k W_{ik})}{1-\Phi(\Sigma \gamma_k W_{ik})} for Z_i = 0$$

where $\phi(\cdot)$ is the standard normal density function. In the second step, the resulting inverse Mills' ratio is used in the subsequent ordinary least square regression:

$$Y_i = \Sigma \beta_k X_{ik} + \beta_\lambda \lambda_i + \varepsilon_i$$

Initial analyses showed that the distribution of the error variable ε_i was positively skewed (non-normality). The log transformation of the dependent variable ($Y_i' = \log Y_i$) corrected this problem.

Moreover, in order to analyse the robustness of the multiple regression we tested the possibility of increasing the robustness by eliminating the outliers. One way of detecting these outliers is through Cook's distance, which when it is greater than 1 indicates that a sample individual is an outlier. Moreover, we tested Gaussian white noise through the four required conditions of regression analysis: (1) the error variable ε is normally distributed; (2) the mean value of the error variable is zero, i.e., $E(\varepsilon)=0$; (3) the variance of the error variable is $Var(\varepsilon)=\sigma^2$, which is a fixed but unknown value (homoscedasticity); and (4) the values of the error variable are independent of one another, i.e, $Cov(\varepsilon_i,\varepsilon_j)=0$, for every $i \neq j$.

Finally, the current research is cross-sectional in nature, and uses a single data source for strategic performance indicators, which could result in common method variance. To minimise this risk, respondents were guaranteed perfect anonymity, and the questionnaire was pre-tested to provide evidence about respondents' understanding of the questions. After the database was constructed, we ran Harman's single-

factor test to exclude the possibility of common method variance, as previous authors have done (see Li et al., 2007).

4. RESULTS

4.1. Sample characteristics

Table 2 presents the means, standard deviations, and correlations of the independent variables. The average entrepreneur in our sample was 40 years old at the time of data collection. Concerning founder gender, 87.7 percent of our sample are men. 67.9 percent of the founders participating in the study have a Degree in Business Administration or economics and another 2.5 percent a Master in Science or Technology. 85.5 percent of the ventures operate in high-technology service sectors, whereas 14.5 percent operate in high-technology manufacturing sectors. We found it extremely interesting that 36.7 percent of the TBFs have some international activity while 28.5 percent (47 observations) follow the technological pioneering strategy.

Table 2. Descriptive statistics and correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. Founder gender														
2. Pioneering														
3. Founder age			--											
4. Innovation			.125	--										
5. Degree in Bus. Admin.			.130*	.197**	--									
6. Master in Science			-.055	.116	.103	--								
7. Management exp.			.257***	.150*	.295***	.067	--							
8. Investment partners			-.155*	-.004	.240***	.017	.171**	--						
9. Technology partners			-.043	.234***	.068	.058	.038	.492***	--					
10. Fit			.117	.352***	.552***	.402***	.490***	.594***	.521***	--				
11. Mill's ratio			.078	.459***	.023	-.050	.170**	.065	.180**	.348***	--			
12. Log (For. mark. perf.)			-.032	.256***	.018	.048	.030	.166**	.169**	.213***	.178**	--		
13. Log (Gen &dom perf)			-.067	.204***	.079	.091	-.073	.070	.112	.069	.020	.221**	--	
14. Profit			.073	.047	.048	.017	.351***	.243**	.179*	.290***	.020	.069	.031	--
Mean	**.877**	**.286**	**40.06**	**.004**	**2.315**	**1.975**	**1.543**	**1.943**	**2.245**	**.165**	**.551**	**.571**	**1.336**	**45,585**
S.D.	**--**	**--**	**8.56**	**1.00**	**1.47**	**1.37**	**1.09**	**1.59**	**1.72**	**.13**	**.41**	**.50**	**.371**	**60,746**

[a]Dummy variables
*p<.10; **p<.05; ***p<.01.

4.2. Entrepreneur's resource endowment and the choice of the technological pioneering strategy

Table 3 presents the results of the probit model estimating the influence of the human and social resources when choosing the technological pioneering strategy. This model shows that the older the entrepreneur, the greater the probability of pursuing the technological pioneering strategy. This is the only variable that has a significant influence on that dependent variable.

Table 3. Influence of human and social capital on strategy choice in TBFs (probit model)

Dependent Variable	Technological pioneering strategy	
Independent Variables	**Coefficient**	χ^2
Constant	-1.921***	9.20
Founder age	+.039***	7.37
Founder gender	-.346	.99
Degree in Bus. Admin.	-.029	.12
Master in Science	-.035	.18
Management exp.	-.015	.02
Investment partners	+.032	.12
Technology partners	+.088	1.49
No. observations	154	
Log likelihood	-88.66	

***p<.01.

4.3. Comparing strategic and financial performance between aligned and non-aligned firms

We carried out a number of difference of means tests in order to explore the possible positive effect of adopting the technological pioneering strategy on the firm's performance when the TBF has the necessary resources for its implementation. We can say that these tests can only provide evidence on the possible relation between the variables in this study, not on causes. Specifically, we used three performance measures: Generic and domestic performance (Factor 1 from Table 1), Foreign market performance (Factor 2 from Table 1), and Earnings before taxes, with the first two being used as strategic performance measures. As we used a single data source for the strategic performance measures, we first ran the Harman tests. The unrotated principal components factor analysis, principal components analysis with varimax rotation, and principal axis analysis with varimax rotation all reveal the presence of four distinct factors with an eigenvalue greater than 1.0, rather than a single factor. The three factors together account for 62 percent of the total variance; the first (largest) factor does not account for a majority of the variance (26%). Thus no general factor is apparent. While the results of these analyses do not preclude the possibility of common method variance, they do suggest that common method variance is not of great concern and so is unlikely to confound interpretation of the results. Thus we analyzed the results.

From the ideal profile theoretically established, we measured the variable *Fit*, the similarity between each TBF in the sample and the ideal profile. Its range is $0 \leq Fit \leq 1$. When $Fit = 1$, the firm exactly fits the ideal profile, and when $Fit = 0$, there is no coincidence between the firm's profile and the ideal one. Our sample was split into two sub-samples: Aligned firms are those for which *Fit* is higher than the median, and non-aligned firms are those for which *Fit* is lower than the median.

We expected aligned ventures to have higher profits (Earnings before taxes) than non-aligned firms (Table

4). Assuming that profits are not normally distributed, we used the Wilcoxon Rank Sum Test to test the null hypothesis that no difference exists in the profits against the alternative hypothesis that the profits in the aligned group are higher. The test statistic equals 2,106.5, and its standardized Z value is -1.7678. The one-sided p-value Pr< Z equals 0.0385. This supports the alternative hypothesis (p-value<0.05) that the profits are higher in the aligned firms than in the non-aligned ones. Assuming that profits are normally distributed, we used the t-test to explore the relations under study. The table 4 reports a group test statistic for the equality of means for both equal and unequal variances. Tests provide evidence of a significant difference in profits between aligned and non-aligned firms, with the aligned TBFs showing higher profits.

Table 4. Comparing profits between aligned and non-aligned firms

Wilcoxon Rank Sum Test			**T-test**		
Group	**N**	**Sum of scores**	**N**	**Mean**	**SD**
Aligned firms	49	2,646.5	49	77,283	221,724
Non-aligned firms	48	2,106.5	48	16,816	51,938
	Statistic	2,106.5	Statistic (equal variances)		1.84
	Normal approximation Z	-1.7678	One-sided Pr>t		.0344
	One-sided Pr<Z	.0385	Statistic (unequal variances)		1.86
			One-sided Pr>t		.0343

We also expected aligned ventures to have a superior strategic performance. Specifically, both the non-parametric test (Wilcoxon Rank Sum Test) and the parametric test (t-test) indicate that there is enough evidence (p<0.05 in the Wilcoxon Rank Sum test and p<0.10 in the t-test) to allow us to conclude that the mean Foreign market performance of aligned firms exceeds that of non-aligned firms (Table 5). However, the results do not support this thesis for factor 1 (Generic and domestic performance), as both tests provide insufficient evidence of a difference in mean Generic and domestic performance between the two groups.

Table 5. Comparing strategic performance between aligned and non-aligned firms

Wilcoxon Rank Sum Test			**T-test**		
Generic and domestic performance (factor 1)					
Group	**N**	**Sum of scores**	**N**	**Mean**	**SD**
Aligned firms	49	2,534	49	.1137	1.0468
Non-aligned firms	48	2,219	48	-.116	.9467
	Statistic	2,219	Statistic (equal variances)		-1.13
	Normal approximation Z	-.9560	One-sided Pr>t		.2601
	One-sided Pr<Z	.1695	Statistic (unequal variances)		-1.13
			One-sided Pr>t		.2596
Foreign market performance (factor 2)					
Group	**N**	**Sum of scores**	**N**	**Mean**	**SD**
Aligned firms	49	2,632	49	.1809	1.2219
Non-aligned firms	48	2,121	48	-.185	.67
	Statistic	2,121	Statistic (equal variances)		-1.82
	Normal approximation Z	-1.6631	One-sided Pr>t		.0717
	One-sided Pr<Z	.0481	Statistic (unequal variances)		-1.83
			One-sided Pr>t		.0710

4.4. Statistical model estimation: Exploring the direct and configuration effects

In order to analyze the direct and configuration effects that the entrepreneur's resource endowment and chosen strategy have on performance, three linear regression models were estimated with the dependent variables being Earnings before taxes, Generic and domestic performance, and Foreign market performance, respectively. The only significant results came from the linear regression model with the Foreign market performance variable, providing similar results to the difference of means test for strategic performance. Specifically, the analysis of variance (F-test) done in the regressions using Earnings before taxes and Generic and domestic performance as dependent variables shows that none of the independent variables are linearly related to these performance indicators, and therefore such models are of little use. Contrasts of difference of means found a positive effect that adopting a technological pioneering strategy would have on the firm's financial results when the TBF has the necessary resources for its implantation. However, it is understandable to say that these contrasts may not be sufficient to support the formulated hypothesis 1, although may provide evidence on the possible relation and behavior of the variables in this study.

Table 6 shows the results of the direct and configuration effects obtained using factor 2 as a performance indicator. The analysis of variance (F=2.23**) is significant. Note that Mill's ratio is not significant when the Fit variable is added to the model, and so there is no emerging evidence of non-random selection of entrepreneurs across the different strategies. We also tested the Cook's distance to analyze the robustness of the multiple regression. The highest Cook's distance found in the analysis was for case number 32 in the regression including the configuration effects: 0.12659, well below 1. With respect to the white noise error terms (Gaussian white noise), we tested the four required conditions. In our model, the mean value of the residuals is zero (condition 2 satisfied). The skewness is 0.0013 and the kurtosis is -0.0781. As these values are in the interval [-2, 2], condition 1 is satisfied. The value of the Durbin-Watson statistic is close to 2 if the errors are uncorrelated. In our model, it is 2.050. That means that there is strong evidence that the errors are uncorrelated (condition 4 satisfied). There are several methods of testing for the presence of homoscedasticity. We used White's General test (White, 1980). The White test is computed by finding nR^2 from a regression of e_i^2 on $\hat{y}_i$, including a constant. This statistic is asymptotically distributed as chi-square with 1 degree of freedom. In our case, $nR^2=0.675$, so we accept the null hypothesis (the variance of the error variable is constant) and condition 3 is satisfied. With respect to the results, the Fit variable is positive and

significant ($p<0.05$), indicating support for our hypothesis H2 which stated that the better the fit between the TBF and the theoretically derived ideal type, the better the venture's strategic performance. Specifically, the greater the entrepreneur's human and social resources when the TBF chooses the technological pioneering strategy, the greater the Foreign market performance.

Table 6. Direct and configuration effects on Foreign market performance (OLS regressions)

Dependent variable	Log(foreign market performance) Model 1 Direct Effects		Log(foreign market performance) Model 2 Configuration Effects	
Independent Variables	**Coefficient**	**t-value**	**Coefficient**	**t-value**
Constant	.666**	2.80	1.116***	3.50
Control variables				
Founder age	-.002	-.39	-.002	-.30
Founder gender	-.154	-1.20	-.146	-1.15
Innovation	.075	1.56	.093*	1.91
Human capital variables				
Degree in Bus. Admin.	-.024	-.80	-.113**	-2.18
Master in Science	.005	.18	-.093*	-1.68
Management exp.	-.021	-.52	-.126*	-1.97
Social capital variables				
Investment partners	.082**	2.46	-.001	-.01
Technology partners	-.010	-.36	-.074*	-1.79
Strategic variables				
Pioneering	-.032	-.28	-.390*	-1.91
Mill's ratio	.165*	1.27	.142	1.11
Configuration Fit			3.063**	2.09
F	1.97**		2.23**	
R^2	.121		.147	
Final adjusted R^2	.060		.081	

*p<.10; **p<.05; ***p<.01.

5. DISCUSSION AND CONCLUSIONS

Our study contributes to the literature on the new TBF by introducing a configuration approach that encompasses the entrepreneur's capital endowment and technological pioneering strategy, analyzing the adjustment between such variables as an antecedent of new TBF performance. Specifically, we study financial and strategic performance measures distinguishing Earnings before tax, Generic and domestic issues –e.g., success of the venture, sales growth in domestic market– and Foreign markets issues –e.g., sales growth in foreign markets, increase of foreign markets–, with the latter referring to the phenomenon of the early internationalization as all the firms in this sample are young and independent (Fernhaber et al., 2007; Kuivalainen et al., 2007; Weerawardena et al., 2007). Entrepreneur's capital endowment includes human capital (Colombo and Grilli, 2005; Shrader and Siegel, 2007) and social capital (Atuahene-Gima et al., 2006) as key resources in technological entrepreneurship. Our focus is also on technological strategy as the most relevant difference in strategy across technology-based ventures is the degree of technical innovation

(Aspelund et al., 2005). Additionally, researchers consider the pioneering strategy important due to its potential contribution to the growth and survival of the new ventures (Aspelund et al., 2005; Zahra et al., 1995).

However, although the entrepreneur's resources and strategy have been mainly studied as direct antecedents of performance of the new venture (Boulding and Christen, 2003; Kakati, 2003; Lee and Grewal, 2004), the results for the new TBF are divergent (e.g., Aspelund et al., 2005; Atuahene-Gima et al., 2006; Kakati, 2003). Our study reached similar conclusions as direct effects of the technological strategy, the human capital or social capital resources on three performance measures of the TBF could not be identified. As regards the technological strategy, the results suggested that adopting a pioneer or follower behavior does not affect the results, probably due to the fact that the pioneering strategy constitutes a risk option as this may create and destroy value (Zahra et al., 1995) and not all the new ventures can implant this successfully. Furthermore the follower may achieve advantages from the pioneer by avoiding investments and risks where this incurs (Park and Bae, 2004).

As regards the entrepreneur's resources, only the invest partner variable, as a measure of social capital, shows a direct and positive influence on one of the three analyzed results, that is, Foreign market performance. Therefore the investment of venture capital or business angel in TBFs affects their level of early internationalization. That could be true since introducing a new highly innovative product in multiple markets in the first years of the firm, not only involves taking a great risk, but also requires a high level of financial resources not available to many new independent TBFs without the help of the invest partners. Therefore, such entrepreneurs often seek partners that complement their own financial resources by developing effective networks that make the smooth running and the higher performance of their firms possible (Mort and Weerawardena, 2006). Second, venture capital firms provide these financial resources to mainly technology- based, growth-oriented new ventures. Thus, new TBFs wishing to access those funds should develop an international strategy in order to achieve the high growth required by the venture capital firm (Fernhaber et al., 2007). Therefore, and with the named exception, our results do not support the existence of a direct relation between the availability of human and social capital by the entrepreneur and the performance of the founded venture when this is a TBF.

Alongside the research of the direct effects of resource-performance and strategy-performance, the influence that both groups of variables exert on the performance of the new TBF can be tested by using the configuration approach. Specifically, our results indicate that the adjustment between the chosen technological strategy and the resources that enable their implantation explain the TBF performance, when this is measured through strategic measures and expressly by means of Foreign market performance. This indicator refers to the scope and scale achieved in international markets by the new TBFs. Therefore if the configuration approach is adopted, it may indicate that both the human capital and social capital are determining factors in the early internationalization of the TBF when those resources adjust to the requirements of a technological pioneering strategy. This would enable an effective strategy implantation, that is, it would be able to obtain first-mover profits at the same time as creating barriers to protect the competitive advantage and making it sustainable in the long run. As Zhou (2007) asserts that the driving mechanism of early internationalization, a phenomenon that challenges the dominant logic of time-based experience, remains an interesting puzzle, our research work contributes to unravel that puzzle for the TBFs.

In addition, the post hoc statistical analyses carried out indicate that the financial benefits for the TBFs are greater in the venture group that correspond to the ideal model identified in theory for the pioneering strategy. These results likewise suggest the need to rely on a high capital endowment so that the technological pioneering strategy can be successfully executed thus creating ordinary profits which will guarantee to a greater extent the survival of the fitted TBFs than the non-fitted TBFs. To the contrary, the post hoc analyses do not provide evidence on the existence of differences in Domestic and generic performance between fitted and non-fitted TBFs. This absence of relation could indicate that different technological strategies and bundle of resources exist which may allow good results in the domestic market to be achieved. For example, a TBF could use a follower strategy, absorbing foreign pioneering technologies and adapting them to offer specific products in a segment of his local market, counting on a medium level of capital endowment, and resulting in achieving a similar performance as other TBFs following a pioneering strategy with a high capital endowment.

Furthermore the configuration analysis carried out reveals how each of the entrepreneur's resources may by themselves, as well as the choice of a technological pioneering strategy, have a negative influence on the strategic performance measured through the early internationalization. This is so because only when the TBF

adopts the ideal type –i.e., chooses the technological pioneering strategy relying on a large level of human and social capital, that is, has a high value in the fit variable– it may achieve high international strategic performance levels. Should this not be the case it would be the follower strategy by itself which would guarantee a better strategic performance. Similarly, the higher levels of human capital could guide the technological entrepreneur who takes on the greater risk associated with a new TBF (Nesheim, 1997) to delay the venture's internationalization until the TBF's position in the domestic market is consolidated.

Our findings may be useful for new technological entrepreneurs. Of interest for them may be our results on the importance of taking into account the human and social capital resources controlled by them before choosing a particular technological strategy. In fact, strategy depends on the willful choices and actions of the TBFs' founders who are free to decide on different strategies. Our study provides some key resources which new TBFs must control to successfully implement a pioneering technological strategy and achieve fast internationalization: University degree in MBA, Master in Science or Technology, management experience in large firms, access to invest partners and access to technological partners.

This research suffers from a number of limitations that, when considered, might help advance future research. First, although extant literature has highlighted how difficult it is for the TBFs alongside the new ventures to survive (Nesheim, 1997), all the firms in our sample have survived the start-up stage. Thus, firms that did not survive were not taken into account and there may be a "survival bias" in our sample, as warned by Kuivalainen et al. (2007). Future research should include not only successful firms but also those firms that did not survive. The second concerns the context of analysis, which is limited to new TBFs located in Spain. Thus, results should not be generalized without first determining if geographical context –e.g., country cultural values–, which characterize the country concerned contribute to understanding the strategic choice of the technological entrepreneur, as well as early internationalization of TBFs –i.e., strategic performance. In this sense, given the fact that Spain is a country where firms encounter difficulties in being internationally competitive, Spanish TBFs spreading their operation into new international markets represents a truly entrepreneurial and challenging activity. The authors consequently recommend examining these results and comparing them to other geographic locations.

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